show that when a period of abnormal weather prevails over a considerable area of the United States, there is a disarrangement of the normal distribution of atmospheric pressure over a great part of the Northern Hemisphere. They show that in the presence of unseasonable weather in any part of the Northern Hemisphere the so-called permanent continental and oceanic areas of high and low barometric pressure present abnormal aspects, and there is an interruption in the normal succession and progression of the areas of high and low barometric pressure of the middle latitudes.

Admitting the possibility of a primary cause of unseasonable weather that first affects the earth's atmosphere as a whole, by disarranging the normal distribution of atmospheric pressure and finally interrupts the usual succession over the continents and oceans of areas of high barometer and general storms, there is presented a fascinating field for speculation and study. Speculation regarding the nature of the cause would naturally be directed toward supposed evidence of solar disturbances as indicated by sun spots, to manifestations of the electro-magnetic influence of the sun's radiant energy, or perhaps to planetary or other equally obscure and possibly imaginary influences. Study should begin with facts presented at the surface of the earth. In the outline of these facts the association of periods of unseasonable weather with local, continental, and hemispherical barometric pressure has been shown.

A study of international meteorological reports conducted with a due regard for the facts referred to would be calculated to lead to a determination of the relation between changes and movements in the smaller and the greater barometric areas, and to an association of changes in the greater barometric areas with some cause that is external to the earth's atmosphere. It is possible also that study carried along these lines would lead to the discovery that periods of unseasonable weather in any part of the Northern Hemisphere are preceded days and perhaps weeks by certain changes in the hemispherical system of barometric pressure, and that all changes and conditions that are observed in our atmosphere, and that all kinds and types of weather that we experience are subject to definable laws of causation.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see page 340.]

Notes on the weather.—On the Pacific slope the rainfall was abundant and of daily occurrence until the 22d, after which there was a marked interruption, corresponding to the so-called veranills de San Juan. On the whole, the total amount at most stations was below the normal. At San Jose the pressure was generally below the normal, the lowest observed (660.6 mm. at 4 p. m. on the 1st and 2d) being the absolute minimum since 1888. The temperature was slightly above normal. On the Atlantic slope the rainfall was about normal, but there was a general complaint about the heat. Electric storms, with abundant showers, have been reported from several stations.

Notes on earthquakes.—June 12, $11^h\,04^m$ p. m., slight shock, NNW–SSE, duration 12 seconds, intensity II. June 14, $5^h\,40^m$ p. m., slight shock, E–W, duration 3 seconds, intensity II. June 20, $5^h\,45^m$ p. m., slight shock, E–W, duration 7 seconds, intensity II. June 26, $0^h\,29^m$ a. m., sensible tremors, E–W, generally felt, duration 12 seconds, intensity III.

A WATERSPOUT AT CLOSE RANGE.[1]

By Dr. O. L. FASSIG, Section Director.

Although the mechanism and mode of occurrence of waterspouts are now fairly well understood, descriptions of these erratic phenomena are always interesting and instructive when coming from an eye witness. It is still a rare occurrence to meet with an intelligent observer who has seen a waterspout at close range. Capt. Fergus Ferguson, of the British steamship *Hestia*, in a recent interview gave a most interesting account of facts that came under his observation while on his way from Baltimore to the Cuban port of Daiquiri. On April 4, toward sunset, while passing off Hatteras, the captain observed several waterspouts in process of formation at a distance of 300 to 400 yards to windward. The largest of these, and the only one completely formed, seemed to be headed directly toward the ship. The captain at first attempted to change his course enough to avoid a collision, but soon discovered that this could not be done. Giving orders for all on deck to go below, he remained until the spout was close upon his ship and then hastily sought a place of safety. A deafening roar was quickly followed by strong wind gusts and a sudden shock as the spout struck amidships and passed over the deck in the direction of the storm. Captain Ferguson reappeared upon deck in time to see two tarpaulins which had covered the hatches, and a plank 8 feet long by 10 inches wide, high up in the air, while his log line with log attached extended straight up into the air to a distance of 40 feet. Beyond the loss of the lighter movable objects on deck and a temporary feeling of apprehension, no harm was done.

When first seen, the waterspout was incomplete. A portion of cloud dipped down from the general cloud level of about 2,000 feet, while at the same time a column of water was apparently rising from the ocean surface just below. At an elevation of between 200 and 300 feet the ascending water column and the descending cloud column met. The diameter of the spout was between 40 and 50 feet, or approximately the width of the *Hestia*. Within the column there was a dark core, almost black, with a diameter of about 2 feet. The captain did not clearly recall evidences of a whirling motion, but a strong upward suction is clearly indicated by the facts noted above. No reference was made to any considerable quantity of water being shipped as the waterspout passed over the vessel, a fact which would indicate that the lower portion of the column was composed mostly of spray formed by the friction of the winds with the surface of the water and carried up by the ascending currents of air.

The weather map for April 4 shows the *Hestia* to have been near the center of a barometric depression which had been moving eastward until the evening of the 4th, when the course was abruptly changed to nearly due north. The local weather conditions are described by third officer W. E. Jenkins in the following report published in the Hydrographic Bulletin for April 23, 1902:

> On the voyage from Baltimore toward Daiquiri, on April 4, 1902, one hour's run south of latitude 35° north, longitude 75° west, observed several waterspouts close at hand, one of which passed over the after end of the ship at 5 p. m. A fresh southwesterly, but unsteady breeze had been blowing; heavy masses of dark thunder clouds hung in the southwest, and the barometer was falling rapidly. The waterspout tore the tarpaulins off the hatches, took everything movable off the deck, and lifted the patent log right up in the air. At 5 p. m., barometer still falling, wind increasing to a fierce gale, with terrific squalls and much vivid lightning and deafening peals of thunder. At 11 p. m., latitude 34° 28′ north, longitude 74° 56′ west, the barometer reached its lowest reading, and the wind suddenly shifted in a fierce squall from southwest, 10, through west to northwest, 8, slightly moderating.

[1] Prepared for the April number of Maryland and Delaware Climate and Crop Report.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

GENERAL SUMMARY FOR JUNE, 1902.

Honolulu.—The water in the artesian well fell during the month from 33.85 to 33.50 feet above mean sea level. June 30, 1901, it stood at 32.85. The average daily mean sea level

for the month was 9.76 feet, 10.00 representing the assumed annual mean. Trade wind days, 14 (2 of north-northeast); normal number for this month, 26. Average force of wind (during daylight), Beaufort scale, 1.5. Cloudiness, in tenths of sky, 3.3; normal, in tenths of sky, 4.0.

Rainfall data for June, 1902.

Stations.	Elevation.	Amount.
HAWAII.		
HILO, e. and ne.	*Feet.*	*Inches.*
Waiakea	50	3.09
Hilo (town)	100	3.57
Kaumana	1,250	5.25
Pepeekeo	100	5.09
Hakalau	200	7.40
Honohina	300	7.48
Puuohua	1,050	12.38
Laupahoehoe	500	9.75
Ookala	400	4.17
HAMAKUA, ne.		
Kukaiau	250	5.99
Paauhau (Mill)	300	6.22
Honokaa (Muir)	425	6.63
Kukuihaele	700	6.86
KOHALA, n.		
Niulii	200	4.47
Kohala (Mission)	521	7.36
Kohala (Sugar Co.)	235	5.47
Puuhue Ranch	1,847	6.73
Hawi	600	7.85
Waimea	2,720	1.57
KONA, w.		
Holualoa	1,350	6.54
Kealakekua	1,580	8.23
Napoopoo	25	3.50
KAU, se.		
Kahuku Ranch	1,680	1.27
Honuapo	15	1.91
Naalehu	650	2.46
Hilea	310	1.30
Pahala	850	5.15
PUNA, e.		
Volcano House	4,000	1.75
Olaa, Mountain View	1,700	5.04
Kapoho	110	5.45
MAUI.		
Waiopae Ranch, s	700	0.86
Kaupo (Mokulau), s	285	1.87
Kipahulu	300	1.86
Nahiku	850	5.57
Nahiku	1,600	10.01
Haiku	700	2.87
Kula (Erehwon)	4,500	6.75
Puuomalei	1,400	4.70
Paia	180	1.44
Haleakala Ranch	2,000	4.82
Wailuku	200	1.31
Waiakoa	2,700	3.18
OAHU.		
Punahou (W. B.), sw	47	1.19
OAHU—*Continued.*	*Feet.*	*Inches.*
Makiki Reservoir	120	1.26
U. S. Naval Station, sw	6	1.12
Kapiolani Park, sw	10	1.08
Manoa (Woodlawn Dairy), c	285	2.33
Manoa (Rhodes)	300	3.93
School street (Bishop), sw	50	1.41
Insane Asylum, sw	30	1.76
Kalihi-Uka, sw	260	3.04
Nuuanu (W. W. Hall), sw	50	1.75
Nuuanu (Luakaha), c	850	4.47
Maunawili, ne	300	3.76
Ahuimanu, ne	350	5.54
Kahuku, n	25	2.44
Waialua	20	0.71
Ewa Plantation, s	60	1.20
Waipahu, s	200	0.40
Moanalua, sw	15	1.24
Magnetic Observatory	50	3.21
KAUAI.		
Lihue (Grove Farm), e	200	1.52
Lihue (Molokoa), e	300	2.15
Lihue (Kukaua), e	1,000	4.50
Kealia, e	15	2.90
Kilauea, ne	325	6.76
Hanalei, n	10	7.58
Waiawa	32	0.15
Eleele, s	200	0.49
Wahiawa Mountain, s	2,100	8.50
Lawai Mauka	450	1.56
McBryde (Residence)	850	1.85
East Lawai	800	1.83
West Lawai	200	0.55
Delayed May reports.		
Magnetic Station		0.26
Hawi Mill		10.82
Honokaa (Meinecke)		18.44
Honokaa (Muir)		13.45
Kula (Erehwon)		0.54
West Lawai		2.58
East Lawai		4.35
Wahiawa Mountain, s		18.25
Eleele		0.95
Waiawa		0.34
Paia		3.85
Kipahulu		5.09
Kapoho		6.82
Nahiku		22.85
Ookala		23.62
Kahuku Ranch		1.36
Kailua		3.87

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

Approximate percentages of district rainfall as compared with normal: South Hilo, 60 per cent; North Hilo, 150; Hamakua, 200; Kohala, 200; Waimea, 115; Kona, 130; Kau, 300; Puna, Olaa region, 50; Puna, Kapoho region, 120; Maui, central, 300; Maui, east coast, 150; Oahu, south, 80; Oahu, north, 150; Kauai, south, 100; Kauai, north, 150.

Mean temperatures: Pepeekeo, Hilo district, 100 feet elevation, mean maximum, 80.6°; mean minimum, 70.6°; Waimea, Hawaii, 2,730 elevation, 79.0° and 64.3°; Kohala, 521 elevation, 81.7° and 69.1°; Nahiku, Maui, 1,600 elevation, 79.1° and 65.5°; Waiakoa, Maui, 2,700 elevation, 80.4° and 61.5°; Ewa Mill, 50 elevation, 84.0° and 69.5°; Magnetic Observatory, 50 elevation, 89.5° and 68.3°; Waikiki Beach, 83.2° and 71.4°.

Mean humidities: Magnetic Observatory, dew-point, 67.6°; relative humidity, 72.0; Ewa Mill, 67.9° and 75; Kohala, Dr. Bond, 68.6° and 82.0.

Heavy surf from the 3d to the 5th, Honolulu; 12th and 29th, Hilo coast, Hawaii. Earthquakes: Hamakua on the 3d at 10 p. m.; Hilo on the 13th at 6:20 a. m. and on the 14th at 3 a. m.; Hamakua and Waimea on the 16th at 4:25 p. m.; Kau has not reported.

The "after glow" and morning glow was very marked throughout the month, being most brilliant about twenty-two minutes after sunset and before sunrise, which would give an elevation of the dust stratum of from 12 to 15 miles, assuming that the most marked coloring would take place at the apparent sunset of that time and elevation. The coloring shaded off from rich yellow to grey green, the daytime corona being whitish grey. There was a recurrence of activity in the central pit crater, Halemaumau, in Kilauea, the breaking upward from below being greatest from the 3d to the 6th. What molten lava there was in the pit was still, however, several hundred feet below the main crater floor and obscured from view by smoke. Many cracks in the main floor, however, revealed heat to the point of redness just below.

There is still a small patch of snow visible on Mauna Kea.

The marked features of the month were, first, the continued low barometer; second, the unusual lack of trade winds; third, the high humidity, altogether making the weather oppressive, although, owing to radiation at night, the average temperature was not excessive.

OBSERVATIONS AT HONOLULU.

The station is at 21° 18′ N., 157° 50′ W.

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Meteorological Observations at Honolulu, June, 1902.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 1:30 a. m. Honolulu time.							Sea-level pressures.		Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.			
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†	‡		‡	‡		§				
1	29.99	70	65.5	81	71	61.3	63	ne.	3	2	30.05	29.98	0.00
2	29.93	66	63	82	69	63.8	70	e.-sw.	1–0	3	29.99	29.91	0.00
3	29.86	70	68	83	64	62.0	71	sw.	1–0	3–6	29.97	29.89	0.00
4	29.84	72	70.7	83	68	70.0	88	sw.	1–0	3–9	29.89	29.83	0.07
5	29.91	70	69.3	83	71	70.5	83	sw.	2–0	3	29.94	29.84	0.02
6	29.97	72	70	82	69	70.0	83	sw.	1–0	2–9	30.01	29.91	0.00
7	29.95	69	67.7	80	69	70.3	86	s.-sw.	1–0	8–4	30.00	29.95	0.08
8	29.96	68	66.5	82	68	67.0	77	se.-ne.	0–1	5–1	30.00	29.93	0.04
9	29.94	69	67.7	85	67	67.7	76	e.-ne.	1	4–0	30.00	29.90	0.00
10	29.97	69	67.7	83	67	70.0	83	s.-ne.	1–0	5	30.02	29.95	0.00
11	29.98	69	66.5	83	68	68.5	80	se.	1–0	3	30.02	29.96	0.00
12	29.94	69	67.7	85	67	66.3	73	ne.	1	1	30.02	29.93	0.00
13	29.88	73	71	85	67	67.0	72	ne.	1–3	2	29.96	29.86	0.01
14	29.87	71	69	83	68	69.3	80	s.-sw.	2–0	3	29.92	29.86	0.00
15	29.90	71	69.7	83	69	69.3	82	sw.	1	1–4	29.94	29.86	0.04
16	29.92	71	69.7	84	68	69.5	81	sw.	1–0	2–0	29.97	29.90	0.01
17	29.89	73	72	84	70	70.3	85	sw.	1–0	4	29.98	29.89	0.55
18	29.88	71	70.3	84	71	71.0	84	sw.	1–0	4	29.91	29.84	0.09
19	29.93	73	68	82	68	70.0	88	se.-e.	1–0	3–10	29.96	29.89	0.19
20	29.98	73	66.5	80	72	65.0	72	ne.	3–4	3–8	29.98	29.93	0.00
21	29.90	67	65	80	72	63.5	66	nne.	3–4	1	29.95	29.89	0.00
22	29.89	66	64.7	82	65	63.7	72	nne.	3–0	2	29.93	29.86	0.00
23	29.91	73	70	85	65	65.5	74	ne.-nw.	1	1	29.96	29.88	0.00
24	29.96	75	69.5	83	68	68.3	79	ne.	0–3	6–2	29.99	29.93	0.05
25	29.99	75	70.5	82	71	68.5	76	ne.	3–1	6–2	30.02	29.96	0.03
26	29.98	70	68	85	73	67.7	71	ne.	3	3	30.04	29.94	0.00
27	29.96	71	69.3	86	70	68.0	74	ne.	3	1	30.00	29.92	0.00
28	30.01	77	70	85	70	69.5	78	se.-ne.	1–3	4–2	30.04	29.96	0.00
29	30.03	77	69	86	76	67.0	66	ne.	2–4	2	30.07	30.00	0.00
30	30.02	76	69.5	83	76	65.5	65	ne.	5	3	30.07	30.00	0.01
Sums													
Means	29.936	71.2	68.4	83.2	69.4	67.9	77.7		1.5	3.3	29.987	29.912	1.19
Departure	—.061					+2.9	+6.7			—0.7			—0.33

Mean temperature for June, 1902, (6 + 2 + 9) + 3 = 75.8; normal is 76.0. Mean pressure for June, 1902, (9 + 3) + 2 = 29.950; normal is 30.011.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4.31 p. m., Greenwich time. ‡ These values are the means of (6 + 9 + 2 + 9) + 4. § Beaufort scale.